

Original research article

## **Surgical Intervention for Crouch Gait in Diplegic Cerebral Palsy- A prospective Case Control Study**

**Dr Ganesh Kumar<sup>1</sup>, Dr Raj Kumar<sup>2</sup>, Dr Sabir Pottichi<sup>3</sup>, Dr Deepak Kumar Sharma<sup>4</sup>, Dr Ajit Kumar Varma<sup>5</sup>**

<sup>1</sup>Assistant Professor, Department of Physical Medicine & Rehabilitation, IGIMS, Patna, Bihar, India

<sup>2</sup>Associate Professor & Head, Department of Physical Medicine & Rehabilitation, IGIMS, Patna, Bihar, India.

<sup>3</sup>Ex-Senior Resident, Department of Physical Medicine & Rehabilitation, IGIMS, Patna, Bihar, India

<sup>4</sup>Ex- Senior Resident, Department of Physical Medicine & Rehabilitation, IGIMS, Patna, Bihar, India

<sup>5</sup>Emeritus Professor, Department of Physical Medicine & Rehabilitation, IGIMS, Patna, Bihar, India

**Corresponding Author: Dr Raj Kumar**

### **Abstract**

**Background:** Common gait patterns in cerebral palsy are equinus, scissoring, jumping, stiff knee, and crouch. Crouch gait is a very resistant condition, it increases the energy costs of walking and can lead to further joint pain and degeneration if not managed. Hamstrings muscle-tendon lengthening is a standard surgical procedure for the correction of crouch or knee flexion deformity.

**Aim of the Study:** To compare the efficacy of rehabilitative surgery with conservative management (Medication, exercise, orthosis, gait training)

**Materials and Methods:** 15 patients in each group are taken. 30 limbs of 15 patients were operated. All patients (study or control) were assessed for any decrease in popliteal angle and improvement of balance at 6 weeks, 6 months, and 1 year on the four-point ordinal scale after surgery and conservative management.

**Result:** In all surgical patient improvement in popliteal angle was noted but only 25% of patients in the control group achieved improvement by one scale (poor to fair) at 1-year follow-up. 60% of patients showed improvement in balance whereas 33.3% of control group patients improved from poor to fair and after 1-year follow-up.

**Conclusion:** Fractional hamstring lengthening is a relatively easily done surgical procedure that results in improvement of popliteal angle as well as balance as compared to the routine conservative management.

**Keywords:** Cerebral Palsy, Crouch Gait, Hamstring lengthening, popliteal angle, balance.

## Introduction

Cerebral palsy (CP) is defined as a qualitative motor disorder of movement and posture usually appearing before the age of 2 years, due to non-progressive damage of the brain, occurring before the growth of the nervous system is complete

The effect of the non progressive damage may however contribute to a secondary musculoskeletal pathology, which is not static but is gradually progressive with age. The diagnostic matrix to be followed in the case of CP includes a detailed history, developmental milestones gait analysis, physical examination of lower limbs, examination of upper extremities and spine, and additional tests for appropriate clinical evaluation.<sup>i</sup>

Depending on the involvement of spasticity or contracture of different muscles, there are different patterns of gait observed in children with CP. Equinus, scissoring, jumping, stiff knee and crouch are commonly recognized gait patterns. Crouch gait/ posture is one of the most resistant conditions to treat in spastic diplegic CP. It is characterized by increased knee flexion throughout the stance phase and, frequently, increased hip flexion and internal rotation<sup>ii</sup>. Walking with a crouch gait increases the energy costs of walking and can lead to further joint pain and degeneration.

A link between crouched gait postures and the capacity of muscles to extend the hip and knee has several clinical implications. If a crouched posture significantly reduces the capacity of muscles to extend the hip or knee joints, individuals may be required to exert more muscle force to maintain a crouched posture. Crouch gait may also alter the accelerations of the hip and knee joints that are induced by gravity, further increasing muscle force requirements. Crouch-related changes in muscle extension capacities may help explain differences in muscle activation when walking with a crouch gait<sup>iii</sup>.

In most cases, commonly done conservative measures like stretching of spastic knee flexors, strengthening of the knee and hip extensors, fitting of orthosis fails<sup>iv</sup>. Even adding antispastic medications, Chemo-denervation like Botulinum toxin -A injection, Alcohol or phenol may fail in resistant cases. So further improvement may be facilitated by rehabilitative surgery.

Hamstring muscle-tendon lengthening is the standard surgical procedure for the correction of crouch or knee flexion deformity<sup>v</sup>. These procedures reduce the strength of hamstring muscles<sup>vi</sup> by Z-lengthening of the tendon or the fractional lengthening of the musculotendinous junction of the medial hamstrings alone or combined with the medial and lateral hamstring<sup>vii</sup>.

Many researchers have utilized various combination of muscle transfer and lengthening.

One recent approach is to transfer distal hamstrings to the distal femur in which the deforming force is utilized for improving hip extension<sup>viii</sup>. The earliest reported operation of this type is Egger's operation. In this operation, the problem of pelvic tilt is solved by improving hip extension. However, genu-recurvatum is a common complication after this procedure.<sup>ix</sup>

Evans, Ray and Ehrlich reported modifications to Egger's technique to avoid this complication.<sup>x</sup><sup>xi</sup>. Kunjabasi Wangjam & A K. Joy Singh modified a little bit in this and transferred semitendinosus and biceps femoris to femoral condyles to function as hip extensor and retain semi- membranous as knee flexor to prevent genu-recurvatum. Semimembranosus is appropriately lengthened to correct knee flexion deformity. Here we have tried to make the procedure very simple and have done fractional lengthening of the semimembranosus, biceps femoris (if required) and semitendinosus is either cut or lengthened.

**Aim of the study:**

The aim of the study was to observe the result, as coming out after the surgical intervention, and also to compare the efficacy of surgery with those groups of patients who were not operated and put on conservative management.

**Materials and Methods**

This study was conducted on 37 consecutive cases of diplegic cerebral palsy, who attended Physical Medicine and Rehabilitation OPD, in 2-year duration period with the following inclusion and exclusion criteria.

**Inclusion criteria:**

Spastic diplegic patient between 5 to 15 year of age of either sex

Crouch gait with or without support

Popliteal angle > 40 degree.

Presence of kneeling standing balance

**Exclusion criteria:**

Age < 5 or > 15 year of age.

Having Ilio-psoas spasticity.

Having significant spasticity in the Adductor group of muscle or Gastrosoleus muscle.

Significant tibial or femoral Rotation.

CP children with Mental retardation; Hearing impairment or Visual impairment.

Out of 37 patients, After the final and on operation table assessment, 4 ( 3 male, 1 female) had to undergo the operation for gastrosoleus release and 3 ( 2 male 1 female) to adductor release. So they were also excluded from the study.

Further, they were divided in 2 groups i.e. experimental/study and control group (who were voluntarily choose to remain on conservative management or not choose surgery at that time).

So Each group had 15 patients irrespective of age and sex. Group 1 had received the surgical intervention (study group) and Group 2 received conservative management (control group)

**Table 1: Age, Sex distribution of both Groups (Group A- Surgical Intervention; Group B- Conservative treatment). IFU – Incomplete Follow up.**

	Group A	Group A IFU	Group B	Group B IFU
Male	8	3	9	2
Female	7	1	6	1
Total	15 (Mean age 8.8yrs)	4 (mean age 8.5yrs)	15 (mean age 8.6yrs)	3 (mean age 7yrs)

After detailed clinical workup and necessary blood and imaging studies. All patients (study or control) were assessed for any decrease in popliteal angle and improvement of balance at 6 weeks, 6 months, and 1 year after surgery or conservative management.

30 limbs of 15 patients were operated. All done in prone position under general anesthesia. The surgical procedure included Hamstring lengthening procedures. In all patients fractional lengthening of semimembranosus was done, 8 limb Biceps femoris was also fractionally lengthened. In 22 limb semitendinosus was sacrificed and cut. it was lengthened by Z plasty in 8 limbs. Then it was closed in layers and a long leg plaster cast was applied.



Fig1: Semitendinosus is exposed.



Fig 2: Semitendinosus is being cut.

Whereas the conservative management included passive stretching and range of motion (ROM) exercises, strengthening exercises, orthosis, and anti-spasticity drugs like baclofen.

At 3 weeks, cast and skin sutures were removed. Active hip extension knee flexion and ankle ROM exercise was done with manual assistance in a few weeks after removal of the cast. Weight-bearing with knee ankle foot orthosis was started after 4 to 6 weeks after surgery. When patients achieved standing balance, they were allowed to walk in a parallel bar under the supervision of a rehab therapist.

The assessment of both groups was done using the following criteria9-

1. Decrease in Popliteal angle scored on 4 points ordinal scale-  
0= poor=<150, 1=fair=>150 but <300,2=good=>300 but < 400, 3=excellent=>400

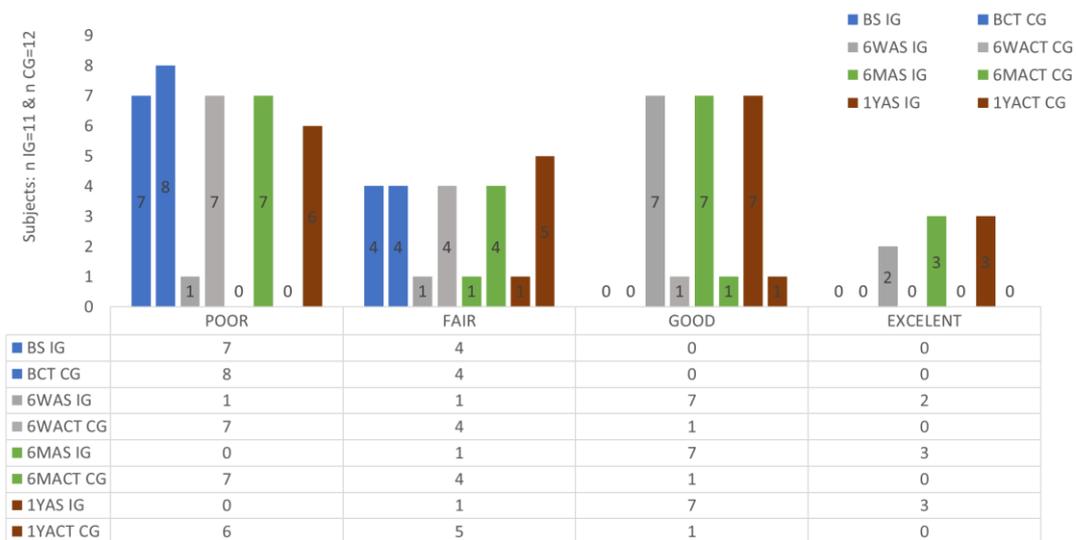
2. Improvement of balance pre-and postoperative period:

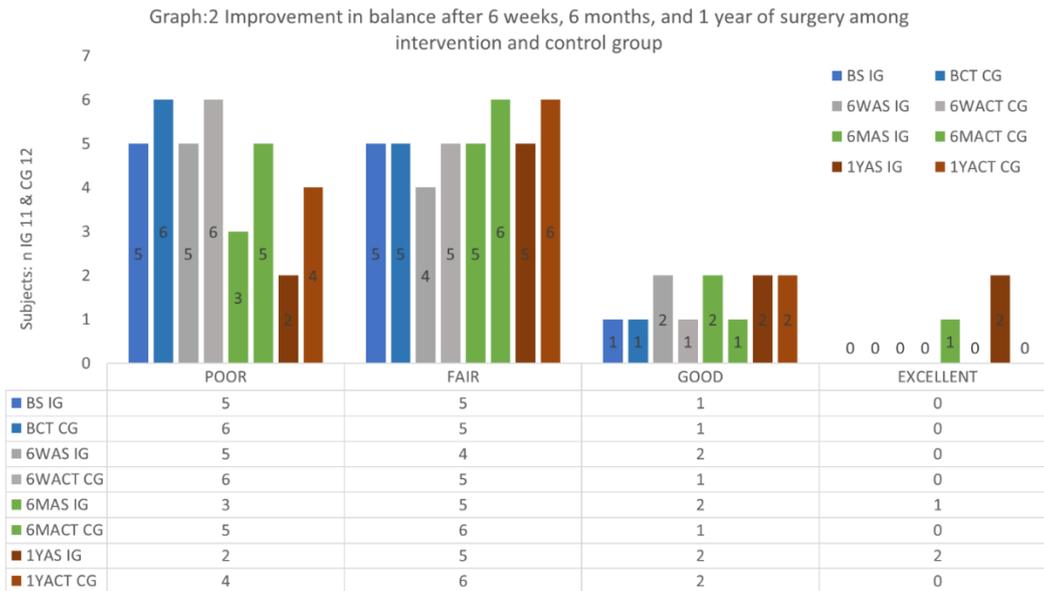
Poor- Kneel standing without support – 1, Fair- Kneel walking – 2, Good- Single leg standing with support – 3, Excellent- Single leg standing without support – 4

Result: Change in popliteal angle in both groups is shown in Graph 1 and Improvement in balance is shown in graph 2.

We have noticed an improvement in popliteal angle in all surgical patients, 3 patients also achieved an excellent decrease without any recurvatum (with AFO). While only 2 patients in the conservative group improved from poor to fair after 1 yr. Nearly similar changes in balance were noted.

Graph:1 Decrease in POPLATEAL ANGLE scored on 4 point ordinal scale among 1st group and 2nd group





Abbreviations used in Graph 1&2: BS IG- Before Surgery Intervention Group, BCT CG- Before Conservative Treatment Control Group, 6WAS IG: 6 Weeks After Surgery Intervention Group, 6WACT CG-6 Weeks After Conservative Treatment Control Group, 6MAS IG- 6 Months After Surgery Intervention Group, 6MACT CG- 6 Months After Conservative Treatment Control Group, 1YAS IG- 1 Year After Surgery Intervention Group, 1YACT CG- 1 Year After Conservative Treatment Control Group, n IG-Number of Subjects in Intervention Group and n CG- Number of Subjects in Control Group.

**Discussion:**

It’s well known that Crouch gait is a resistant condition and difficult to manage and usually requires lengthening of the hamstrings and sometimes iliopsoas too. Along with muscular correction and adequate correction of bony problems such as medial femoral torsion, lateral tibial torsion, and stabilization of the foot is also required if it is. After that a good ground reaction Ankle Foot Orthosis may also be required until the integrity of the plantarflexion- knee extension couple is clearly well established.

We have done only hamstring release as described in methodology and excluded the case of iliopsoas spasticity, associated significant adductor, or gastrocnemius spasticity. We have also not included the case of bony or torsional deformities. Our aim was to observe the result coming out after the selected simple surgical intervention and to compare the efficacy with control who were put on conservative management. Weakening of hamstrings to reduce knee flexion which is the most important component of crouch is the commonest technique used to treat this crouch. Partial distal lengthening of medial or lateral hamstrings, total distal lengthening;xii,xiii and proximal hamstrings lengthening by fractional lengthening or z-plasty are well-known commonly done technique described. We have done fractional lengthening of semimembranosus. Biceps femoris and semitendinosus was cut in 11 patients and lengthened in 4 patients.

Partial lengthening usually leads to re-appearance flexion attitude as a common belief whereas, the total release is associated with the incidence of pelvic tilt and genu-recurvatum. Our motto was to prevent these commonly occurred deformities. We have not noticed any genu-recurvatum in any cases and decrease in popliteal angle and an improvement in balance as described in the result section.

The pelvic tilt is due to weakness of extensor of hip, even if there is no spasticity or contracture of the ilio-psoas. We taught strengthening of hip extensor to all patients preoperatively. It resulted in better compliance postoperatively.

Hoffinger and Abou Ghaida had shown that Hamstrings function as important hip extensors in CP diplegics as shown by dynamic electromyography of hamstrings.<sup>xiv</sup> This may be the reason for achieving better balance in most of the patients.

In one recent study<sup>xv</sup> females demonstrated larger decreases in popliteal angle, larger decreases in mid-stance knee flexion, and higher incidences of knee hyperextension. But we have very few females in the surgical group to get to such a conclusion. But increased hyperextension is not noticed in our study, may be due to guarded surgery and better managed with orthosis(AFO) as well. Co-spasticity of gastrocnemius was also well managed or excluded from this study.

Hamstring lengthening, for the majority of patients, did not lead to a clinically significant change in mean pelvic tilt and improved knee flexion angle at initial contact as clinically noticed in this study.

Randomized control, video gait analysis with kinetics/ kinematics is the major limitation of this paper as it was a clinical study and not done in an experimental setup.

### Conclusion:

In the selective case with Good clinical evaluation, Fractional hamstring lengthening is relatively easily done surgical intervention and also results in having more improvement of popliteal angle as well as balance as compared to the routine conservative management. The procedure has also had a low risk for genu recurvatum.

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